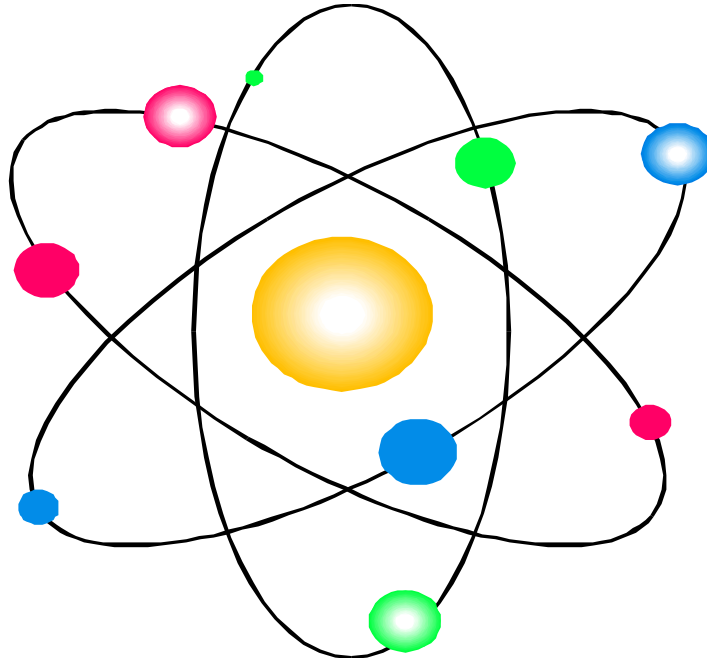


**STATE OF TENNESSEE**  
**DEPARTMENT OF ENVIRONMENT & CONSERVATION**  
Division of Radiological Health  
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**GUIDE**  
**FOR**  
**COMPLETING APPLICATION**  
**FOR RADIOACTIVE MATERIAL LICENSE (RHS 8-5)**  
**FOR PORTABLE MOISTURE DENSITY GAUGE**

(MARCH 2000)

**GUIDE FOR COMPLETING APPLICATION FOR RADIOACTIVE MATERIAL  
LICENSE (RHS 8-5) FOR PORTABLE MOISTURE/DENSITY GAUGE**

(March 2000)

- Item 1.(a) List the applicant's name and mailing address.
- Item 1.(b) Identify the use and/or storage address if different from 1.(a). (A separate license is needed for each permanent use and/or storage address. A multiple site license is available, but at a higher fee.)
- Specify if use is also, or only, at temporary job sites.
- Item 2. Not required.
- Item 3. Only applicable if renewing a license.
- Item 4. Confirm that before using licensed materials, gauge users will have successfully completed a portable moisture/density gauge manufacturer's training course, or an equivalent course that meets the criteria in Appendix A. As an alternative, you may submit a statement of an individual's training and experience. Applicants wishing to be approved to conduct their own training shall state their commitment to the criteria in Appendix A.
- Item 5. Name the Radiation Safety Officer and confirm that before obtaining licensed materials, this individual will have successfully completed one of the training courses described in Item 4. As an alternative, you may provide a statement of training and experience. Typical RSO duties can be found in Appendix B.
- Item 6.(a). Indicate each radionuclide that will be used in each source in the gauging device(s).
- Item 6.(b). Provide the manufacturer and model number for each source that is approved by the regulatory agency having jurisdiction. This can be found in the Registry of Sealed Sources and Devices maintained by the U. S. Nuclear Regulatory Commission (NRC). Specify the activity of each source. State the number of sources to be licensed. To request an unlimited number of sources state "No single source to exceed \_\_\_\_ (the maximum source activity)."

**GUIDE FOR COMPLETING APPLICATION FOR RADIOACTIVE MATERIAL  
LICENSE (RHS 8-5) FOR PORTABLE MOISTURE/DENSITY GAUGE**

(March 2000)

- Item 7. Provide the manufacturer and model number for each gauge approved for licensing. State the general purpose for use of the gauge, i.e. to measure physical properties of materials. State the number of gauges to be licensed or if you wish to be authorized for an unlimited number. (Three or more gauges used at temporary jobsites requires a higher license fee.)
- Items 8 & 9. These need not be completed unless submitting a statement of training and experience as part of Items 4 and 5.
- Item 10. Not required (However, you are responsible to have a survey performed of the gauge in the case of an emergency condition. See Appendix D).
- Item 11. Not required (Unless applying to perform non-routine gauge maintenance or repair. See Appendix C).
- Item 12. Confirm that you will provide gauge users with personnel monitoring devices processed and evaluated by a National Voluntary Laboratory Accreditation Program (NVLAP) approved processor, or that you will maintain for inspection documentation that unmonitored individuals are not likely to receive in one year, a radiation dose in excess of 10 percent of the allowable limits in 1200-2-5 of "State Regulations for Protection Against Radiation." See Appendix E.
- Item 13. Submit a diagram of your permanent gauge storage area or container and its surrounding area. Show distances to unrestricted areas from the location of storage, occupancies, any shielding employed, locking mechanisms, and others means of control to be used. (Gauges shall be controlled such that they can not be tampered with or removed by unauthorized personnel. This requires a locked room, cage, or container [other than the gauge transport case] that is accessible only to licensed personnel. Gauges shall be controlled such that doses to the public including non-occupationally exposed employees will not receive a total effective dose equivalent of 0.1 rem in a year, and that the dose in any unrestricted area does not exceed 0.002 rem in any one hour. See Appendix E. The unrestricted area would be outside the storage area or container).

**GUIDE FOR COMPLETING APPLICATION FOR RADIOACTIVE MATERIAL  
LICENSE (RHS 8-5) FOR PORTABLE MOISTURE/DENSITY GAUGE**

(March 2000)

- Item 14. Except for your storage facility, confirm that you will implement the Operating and Emergency Procedures contained in Appendix D, or submit alternative equivalent procedures.

Verify that leak tests of sealed sources will be performed by the device manufacturer, or other persons authorized by the U.S. Nuclear Regulatory Commission or an Agreement State to provide leak testing services, or that the applicant will collect leak test samples for analysis by one of the above using a leak test kit supplied by persons authorized to provide leak test kits and according to the kit supplier's instructions.

Describe how gauges will be secured during transport to minimize the possibility of loss, tampering, or theft.

Applicants wishing to perform non-routine maintenance or repair of gauges (beyond routine cleaning and lubrication) may submit a request for such in accordance with the elements of Appendix C.

- Item 15. Not applicable (However, note that gauges shall only be transferred to the manufacturer or another person who is properly licensed for its possession or disposal.)

- Item 16. The application shall be signed and dated by a management official for the organization. List this person's title.

## Criteria for Acceptable Training Courses for Portable Gauge Users

### COURSE CONTENT

- 1.5 to 2 hours of radiation safety and regulatory requirements, emphasizing practical subjects important to safe use of the gauge: radiation vs. contamination: internal vs. external exposure; **ALARA** concept; use of time, distance, and shielding to minimize exposure; control and surveillance of gauges; location of sealed source within the portable gauge; inventory; recordkeeping; incidents; licensing and inspection by regulatory agency; need for complete and accurate information; employee protection; deliberate misconduct
- 1.5 to 2 hours of practical explanation of portable gauge theory and operation; operating, emergency, maintenance, and transportation procedures, and field training emphasizing radiation safety and including test runs of: setting up and making measurements with the gauge, controlling and maintaining surveillance over the portable gauge, performing routine cleaning and lubrication, packaging and transporting the gauge, storing the gauge, and following emergency procedures

### COURSE EXAMINATION

- 25-50 questions, closed-book written test--70 percent grade
  - Emphasis on radiation safety of portable gauge storage, use, sealed source location, maintenance, and transportation, rather than the theory and art of making portable gauge measurements
  - Review of correct answers to missed questions with prospective gauge user immediately following the scoring of the test

### COURSE INSTRUCTOR QUALIFICATIONS

Instructor should have either:

- Bachelor's degree in a physical or life science or engineering
- Successful completion of a portable gauge user course
- Successful completion of an 8 hour radiation safety course **AND**
- 8 hours hands-on experience with portable gauges

### OR

- Successful completion of portable gauge user course
- Successful completion of 40 hour radiation safety course **AND**
- 30 hours of hands-on experience with portable gauges

**NOTE:** Licensees should maintain records of training.

- The RSO's duties and responsibilities typically include ensuring the following:
- Stopped licensed activities that the RSO considers unsafe
- Possession, use, storage, and maintenance of sources and gauges are consistent with the limitations in the license, the Sealed Source and Device Registration sheet(s), and manufacturer's recommendations and instructions
- Individuals using gauges are properly trained
- When necessary, personnel monitoring devices are used and exchanged at the proper intervals; records of the results of such monitoring are maintained
- Gauges are properly secured
- Proper authorities are notified in case of accident, damage to gauges, fire, or theft
- Unusual occurrences involving the gauge (e.g., accident, damage) are investigated, cause(s) and appropriate corrective action are identified, and corrective action is taken
- Audits are performed at least annually and documented, and corrective actions taken
- Licensed material is transported in accordance with all applicable DOT requirements
- Licensed material is disposed of properly
- Appropriate records are maintained
- Up-to-date license is maintained and amendment and renewal requests submitted in a timely manner

Non-routine maintenance or repair (beyond routine cleaning and lubrication) involves detaching the source or source rod from the device and any other activities during which personnel could receive radiation doses exceeding "State Regulations for Protection Against Radiation" (SRPAR) limits (Appendix E). If this maintenance or repair is not performed properly with attention to good radiation safety principles, the gauge may not operate as designed and personnel performing these tasks could receive radiation doses exceeding SRPAR limits.

A typical moisture-density gauge contains 0.37 gigabecquerels (10 millicuries) of cesium-137 and 1.5 gigabecquerels (40 millicuries) of americium-241 as a neutron source. In about 9 minutes, an unshielded cesium-137 source of this activity can deliver 0.05 sievert (5 rems) to a worker's hands or fingers (i.e., extremities), assuming the extremities are 1 centimeter from the source. Some gauges contain sources of even higher activities with correspondingly higher dose rates. The threshold for extremity monitoring is 0.05 sievert (5 rems) per year.

Thus, applicants wishing to perform non-routine maintenance must use personnel with special training and follow appropriate procedures consistent with the manufacturer's instructions and recommendations that address radiation safety concerns (e.g., use of radiation survey meter, shielded container for the source, personnel dosimetry). Accordingly, provide the following information:

- Describe the types of work, maintenance, cleaning, repair, etc., to be performed that necessitate detaching the source or source rod from the device or that could cause personnel to receive radiation doses exceeding SRPAR limits. The principal reason for obtaining this information is to assist in the evaluation of the qualifications of individuals who will conduct the work and the radiation safety procedures they will follow.
- Identify who will perform non-routine maintenance, their training and experience, and why they are competent to perform non-routine maintenance.
- Submit procedures for safe handling of the radioactive source while the source or source rod is detached from the gauge. These procedures should ensure the following:
  - doses to personnel and members of the public are within regulatory limits and ALARA (e.g., use of shielded containers or shielding);
  - the source or source rod is secured against unauthorized removal access or under constant surveillance;
  - appropriate labels and signs are used; and
  - manufacturer's instructions and recommendations are followed.
- Confirm that individuals performing non-routine maintenance on gauges will always wear both whole body and extremity monitoring devices or that an evaluation will be available to demonstrate that these individuals are not likely to receive, in one year, more than 10 per cent of the applicable dose limits.

- Verify possession of at least one survey instrument meeting the following criteria:
  - Be capable of detecting gamma radiation;
  - Be capable of measuring from 0.01 to 0.5 mSv/hr [1 to 50 mrem/hr];
  - Be calibrated at least annually with radionuclide point sources emitting radiation of the type and energy of the sealed sources in the gauge;
  - Be calibrated at least 2 points located at approximately 1/3 and 2/3 of each scale; readings within  $\pm 20\%$  are acceptable;
  - Be calibrated by a person specifically licensed by the Department, the NRC, or an Agreement State to calibrate radiation detection instruments; and
  - Be checked for functionality prior to use (e.g., with the gauge or a check source).

Note: Records of instrument calibration must be maintained for 3 years after the record is made (SRPAR 1200-2-5-.132).

- When performing non-routine maintenance, describe steps to be taken to ensure that radiation levels in areas occupied by the public do not exceed SRPAR 1200-2-5-.60. For example, applicants can do the following:
  - commit to performing surveys with a survey instrument (as described above);
  - specify where and when surveys will be conducted during non-routine maintenance; and
  - commit to maintaining, for 3 years from the date of the survey, records of the survey (e.g., who performed the survey, date of the survey, instrument used, measured radiation levels correlated to location of those measurements), as required by 1200-2-5-.132.



**Operating Procedures**

- If personnel dosimetry is provided:
  - Always wear your assigned personnel monitoring device when using the gauge.
  - Never wear another person's personnel monitoring device.
  - Never store your personnel monitoring device near the gauge.
- Before removing the gauge from its place of storage, ensure that, where applicable, each gauge source is in the fully shielded position and that in gauges with a moveable rod containing a sealed source, the source rod is locked (e.g., keyed lock, padlock, mechanical control) in the shielded position. Place the gauge in the transport case and lock the case.
- Sign out the gauge in a log book (that remains at the storage location) including the date(s) of use, name(s) of the authorized users who will be responsible for the gauge, and the temporary jobsite(s) where the gauge will be used.
- Block and brace the gauge to prevent movement during transport and lock the gauge in or to the vehicle. Follow all applicable Department of Transportation (DOT) requirements when transporting the gauge.
- Use the gauge according to the manufacturer's instructions and recommendations.
- Do not touch the unshielded source rod with your fingers, hands, or any part of your body.
- Do not place hands, fingers, feet, or other body parts in the radiation field from an unshielded source.
- Unless absolutely necessary, do not look under the gauge when the source rod is being lowered in the ground. If you must look under the gauge to align the source rod with the hole, follow the manufacturer's procedures to minimize radiation exposure.
- After completing each measurement in which the source is unshielded, immediately return the source to the shielded position.
- Always maintain constant surveillance and immediate control of the gauge when it is not in storage. At jobsites, do not walk away from the gauge when it is left in the ground. Take actions necessary to protect the gauge and yourself from danger of moving equipment.
- Always keep unauthorized persons away from the gauge.
- Perform routine cleaning and maintenance according to the manufacturer's instructions and recommendations.

- When the gauge is not in use at a temporary jobsite, place the gauge in a secured storage location (e.g., locked in the trunk of a car or locked in a storage shed).
- Prior to transporting the gauge, ensure that, where applicable, each gauge is in the fully shielded position. Ensure that in gauges with a moveable source rod, the source rod is locked in the shielded position (e.g., keyed lock, padlock, mechanical control). Place the gauge in the transport case and lock the case. Block and brace the case to prevent movement during transportation. Lock the case in or to the vehicle.
- Return the gauge to its proper locked storage location at the end of the work shift.
- Log the gauge into the daily use log when it is returned to storage.
- If gauges are used for measurements and the unshielded source extended more than 3 feet beneath the surface, use piping, tubing, or other casing material to line the hole from the lowest depth to 12 inches above the surface. If the piping, tubing, or casing material cannot extend 12 inches above the surface, cap the hole liner or take other steps to ensure that the hole is free of debris (and it is unlikely that debris will re-enter the cased hole) so that the unshielded source can move freely (e.g., use a dummy probe to verify that the hole is free of obstructions).
- After making changes affecting the gauge storage area (e.g., changing the location of gauges within the storage area, removing shielding, adding gauges, changing the occupancy of adjacent areas, moving the storage area to a new location), reevaluate compliance with public dose limits and ensure proper security of gauges.

### **Emergency Procedures**

- If the source fails to return to the shielded position (e.g., as a result of being damaged, source becomes stuck below the surface) or if any other emergency or unusual situation arises (e.g., the gauge is struck by a moving vehicle, is dropped, is in a vehicle involved in an accident):
- Immediately secure the area and keep people at least 15 feet away from the gauge until the situation is assessed and radiation levels are unknown. However, perform first aid for any injured individuals and remove them from the area only when medically safe to do so.
- If any heavy equipment is involved, detain the equipment and operator until it is determined there is no contamination present.
- Gauge users and other potentially contaminated individuals should not leave the scene until emergency assistance arrives.

- Notify the persons in the order listed below of the situation:

NAME*	WORK PHONE NUMBER*	HOMEPHONE NUMBER*
_____	_____	_____
_____	_____	_____
_____	_____	_____

- Fill in with (and update, as needed) the names and telephone numbers of appropriate personnel (e.g., the Radiation Safety Officer (RSO), or other knowledgeable licensee staff, licensee's consultant, gauge manufacturer) to be contacted in case of emergency.
- Follow the directions provided by the person contacted above.

### **RSO AND LICENSEE MANAGEMENT**

- Arrange for a radiation survey to be conducted as soon as possible by a knowledgeable person using appropriate radiation detection instrumentation. This person could be a licensee employee using a survey meter located at the jobsite or a consultant. To accurately assess the radiation danger, it is essential that the person performing the survey be competent in the use of a radiation survey meter.
- If gauges are used for measurements with the unshielded source extended more than 3 feet below the surface, contact persons listed on the emergency procedures need to know the steps to be followed to retrieve a stuck source and to convey those steps to the staff on site.
- Make necessary notifications to local authorities as well as the Department as required. (Even if not required to do so, you may report **ANY** incident to the Department by calling the Tennessee Emergency Management Agency's Operations Center at 1-800-262-3300, which is staffed 24 hours a day. Department notification is required when gauges containing licensed material are lost or stolen, when gauges are damaged or involved in incidents that result in doses in excess of SRPAR 1200-2-5-.50, .55, .56, and .60, and when it becomes apparent that attempts to recover a source stuck below the surface will be unsuccessful.
- Reports to the Department must be made within the reporting timeframes specified in SRPAR.
- Reporting requirements are found in SRPAR 1200-2-5-.140, .141, and .143.

**STATE REGULATIONS FOR PROTECTION AGAINST  
RADIATION (SRPAR) DOSE LIMITS**

**1200-2-5-.50      Occupational Dose Limits for Adults**

- (1) Except for planned special exposures under 1200-2-5-.54, the licensee or registrant shall limit the occupational dose to individual adults to the following annual dose limits:
  - (a) The lesser of a total dose equivalent of 5 rems (0.05 Sv) or the sum of the deep-dose equivalent and the committed dose equivalent to any individual organ or tissue, other than the lens of the eye, equal to 50 rems (0.5 Sv).
  - (b) An eye-dose equivalent to 15 rems (0.15 Sv).
  - (c) A shallow-dose equivalent of 50 rems (0.50 Sv) to the skin or to any extremity.
- (2) The amount by which occupational dose from all sources exceeds an individual's annual limits shall be subtracted from the individual's limits for planned special exposures for the current year and for lifetime exposure. See 1200-2-5-.54(6)(a) and (b).
- (3) The assigned deep-dose equivalent and shallow-dose equivalent shall be for the part of the body receiving the highest exposure. Deep-dose, eye-dose and shallow-dose equivalents may be assessed from surveys or other radiation measurements to demonstrate compliance with occupational dose limits. However, this may be done only if the individual monitoring device was not subject to the highest potential exposure, or the individual monitoring results are unavailable.
- (4) Derived air concentration (DAC) and annual limit on intake (ALI) values are presented in Schedule RHS 8-30 and may be used to determine the individual's dose and demonstrate compliance with the occupational dose limits.
- (5) In addition to the annual dose limits, the licensee shall limit the soluble uranium intake by an individual to 10 milligrams in a week in consideration of chemical toxicity (see footnote 3 of Schedule RHS 8-30).
- (6) The licensee shall reduce the dose that an individual may be allowed to receive in the current year by the amount of occupational dose received while employed by any other person.

**Authority:** T.C.A. §§4-5-201 et seq., 68-202-203 and 206. **Administrative History:** Original rule filed October 19, 1993; effective January 2, 1994.

**1200-2-5-.55 Occupational Dose Limits for Minors**

The annual occupational dose limits for minors are 10 percent of the annual dose limits specified for adult workers in 1200-2-5-.50

*Authority:* T.C.A. §§4-5-201 et seq., 68-202-203 and 206. *Administrative History:* Original rule filed October 19, 1993; effective January 2, 1994.

**1200-2-5-.56 Dose to an Embryo/Fetus**

- (1) The licensee or registrant shall ensure that the dose to an embryo/fetus during the entire pregnancy, due to occupational exposure of a declared pregnant woman, does not exceed 0.5 rem (5 mSv). (For recordkeeping requirements see 1200-2-5-.135).
- (2) Using ALARA the licensee or registrant shall make efforts to avoid substantial variation above a uniform monthly exposure rate to a declared pregnant woman.
- (3) The dose to an embryo/fetus shall be taken as the sum of:
  - (a) The deep-dose equivalent to the declared pregnant woman; and
  - (b) The dose to the embryo/fetus from radionuclides in the embryo/fetus and radionuclides in the declared pregnant woman.
- (4) If when a woman declares her pregnancy to the licensee or registrant the dose to the embryo/fetus is found to be 0.45 rem (4.5 mSv) or greater, the embryo/fetus is permitted an additional dose not exceeding 0.05 rem (0.5 mSv) during the remainder of the pregnancy.

*Authority:* T.C.A. §§4-5-201 et seq., 68-202-203 and 206. *Administrative History:* Original rule filed October 19, 1993; effective January 2, 1994.

**1200-2-5-.60 Dose Limits for Individual Members of the Public**

- (1) Each licensee and registrant shall conduct operations so that:
  - (a) The total effective dose equivalent received by any individual member of the public from the licensed or registered operation does not exceed 0.1 rem (1 mSv) in a year. This limit is exclusive of the dose contribution from the licensee's disposal of radioactive material into sanitary sewerage in accordance with 1200-2-5-.122; and
  - (b) The dose in any unrestricted area from external sources does not exceed 0.002 rem (0.02 mSv) in any one hour.

- (2) A licensee, registrant or applicant may apply for prior authorization to operate up to an annual dose limit of 0.5 rem (5 mSv) for an individual member of the public. This application by the licensee, registrant or applicant shall include the following:
  - (a) Demonstration of the need for and the expected duration of operations in excess of the limit in (1) of this Rule;
  - (b) The licensee's or registrant's program to assess and control dose within the 0.5 rem (5 mSv) annual limit; and
  - (c) The procedures to be followed to maintain the dose as low as is reasonably achievable (ALARA).
- (3) In addition to the requirements of this Chapter, a licensee subject to the provisions of EPA's generally applicable environmental radiation standards in 40 CFR Part 190 shall comply with those standards.
- (4) The Division may impose additional restrictions on radiation levels in unrestricted areas and on the total quantity of radionuclides that a licensee may release in effluents in order to restrict the collective dose.

**Authority:** *T.C.A. §§4-5-201 et seq., 68-202-203 and 206. Administrative History:*  
Original rule filed October 19, 1993; effective January 2, 1994.